

## Problems for the 28<sup>th</sup> IYPT 2015

### 1. Packing 堆积 吕景林 徐建军

The fraction of space occupied by granular particles depends on their shape. Pour non-spherical particles such as rice, matches, or M&M's candies into a box. How do characteristics like coordination number, orientational order, or the random close packing fraction depend on the relevant parameters?

被颗粒状物体(particles)占据的小部分空间取决于它们的形状。将例如米、火柴或 M&M 糖果的非球状物体倾倒入一个盒子里，相关参量如何影响配位数、秩序性排列和随机紧密堆积分数(random close packing fraction)这样的特征？

### 2. Plume of Smoke 羽状的烟 苏卫锋 徐建军

If a burning candle is covered by a transparent glass, the flame extinguishes and a steady upward stream of smoke is produced. Investigate the plume of smoke at various magnifications.

如果一支燃烧着的蜡烛被一块透明玻璃板覆盖，火焰会熄灭，并且产生一缕稳定的向上流动的轻烟。研究在各种放大倍数下的羽状的烟。

【此处 plume 有羽状之意，故不将题目翻译为轻烟一缕】

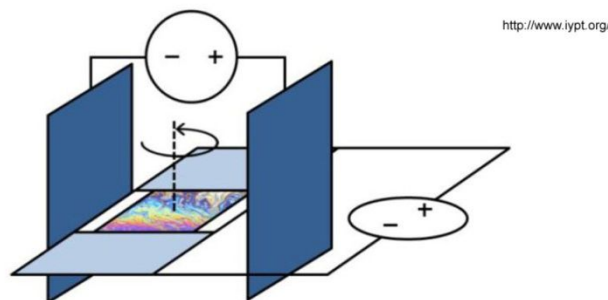
### 3. Artificial Muscle 人造肌肉 陈骏逸 徐建军

Attach a polymer fishing line to an electric drill and apply tension to the line. As it twists, the fibre will form tight coils in a spring-like arrangement. Apply heat to the coils to permanently fix that spring-like shape. When you apply heat again, the coil will contract. Investigate this 'artificial muscle'.

将一个多聚物钓鱼线固定(attach)在电钻上并使其绷紧。当它扭转时，钓鱼线纤维会形成像弹簧一样排列的牢固的线圈。对线圈加热使它定型，成为弹簧一样的形状。当你再次加热时，线圈会收缩。研究这个"人造肌肉"。

### 4. Liquid Film Motor 液体膜发动机 乐永康 徐建军

Form a soap film on a flat frame. Put the film in an electric field parallel to the film surface and pass an electric current through the film. The film rotates in its plane. Investigate and explain the phenomenon.



使一个肥皂膜在平整的边框上形成。将膜放在平行于膜面的电场中并通上贯穿膜的电流。膜会在所在平面中旋转。研究并解释这个现象。

PS.此处的 and 可能不表示并列而表示因果。

#### 5. Two Balloons 双气球 陈元杰 徐建军

Two rubber balloons are partially inflated with air and connected together by a hose with a valve. It is found that depending on initial balloon volumes, the air can flow in different directions. Investigate this phenomenon.

两个橡胶气球被不完全充满气并被一个带阀的塑料管(hose)连接。会发现空气由于初始气球体积不同而流向不同方向这样的现象。研究这个现象。

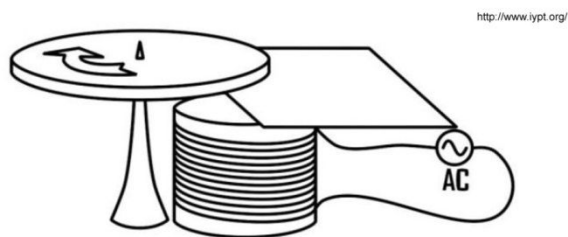
#### 6. Magnus Glider 马格努斯滑翔机 吕景林 徐晓华

Glue the bottoms of two light cups together to make a glider. Wind an elastic band around the centre and hold the free end that remains. While holding the glider, stretch the free end of the elastic band and then release the glider. Investigate its motion.

将两个轻质杯子的底部粘在一起制作一个滑翔机。将一根弹性带子缠绕在滑翔机的中心并抓住余下的自由端。当握着滑翔机时，拉伸带子的自由端然后释放滑翔机。研究它的运动。

#### 7. Shaded Pole 被覆盖的磁极 苏卫锋 徐晓华

Place a non-ferromagnetic metal disk over an electromagnet powered by an AC supply. The disk will be repelled, but not rotated. However, if a non-ferromagnetic metal sheet is partially inserted between the electromagnet and the disk, the disk will rotate. Investigate the phenomenon.



将一个非铁磁性的金属碟放在通交流电的电磁铁上，金属碟会排斥但不会旋转。但如果一块非铁磁性的金属薄片被部分插入两者之间，金属碟会旋转。研究这个现象。

PS.鉴于此处为电磁铁故将 pole 译为磁极。

#### 8. Sugar and Salt 糖和盐 陈唯 杨中芹

When a container with a layer of sugar water placed above a layer of salt water is illuminated, a distinctive fingering pattern may be seen in the projected shadow. Investigate the phenomenon and its dependence on the relevant parameters.

当照明一个装有一层糖水铺在一层盐水上的容器时,我们可能在投射的背光处看到一种独特的指纹形图案。研究这个现象和与相关参量的依赖性。

#### 9. Hovercraft 气垫船 乐永康 徐晓华

A simple model hovercraft can be built using a CD and a balloon filled with air attached via a tube. Exiting air can lift the device making it float over a surface with low friction. Investigate how the relevant parameters influence the time of the 'low-friction' state.

将一张 CD 光盘和一个充满气的气球通过一根管子连接。漏气可以升起装置使其以低摩擦漂浮在一个表面上。研究相关参量如何影响"低摩擦"状态持续的时间。

#### 10. Singing Blades of Grass 振鸣的草叶 陈元杰 黄吉平 陈骏逸

It is possible to produce a sound by blowing across a blade of grass, a paper strip or similar. Investigate this effect.

横过一片草叶或一张纸条或其他类似的东西吹气从而发声是可行的。研究这个现象。

PS.题目中的 singing 解释为唱歌略不妥, 鉴于实际故译为振鸣。

#### 11. Cat's Whisker 猫须接收器 陈骏逸 黄吉平

The first semiconductor diodes, widely used in crystal radios, consisted of a thin wire that lightly touched a crystal of a semiconducting material (e.g. galena). Build your own 'cat's-whisker' diode and investigate its electrical properties.

广泛运用于晶体收音机的第一个半导体二极管包含一个轻触在半导体晶体(例如方铅矿)的细导线。自制"猫须接收器"半导体元件并研究它的电学特性。

#### 12. Thick Lens 厚透镜 陈元杰 黄吉平

A bottle filled with a liquid can work as a lens. Arguably, such a bottle is dangerous if left on a table on a sunny day. Can one use such a 'lens' to scorch a surface?

一个装满液体的瓶子可以用作透镜。有人认为(arguably)如果将这样的瓶子在晴天放在桌子上会造成危险。可以用这样的"透镜"来烤焦一个表面吗?

#### 13. Magnetic Pendulum 磁力摆 乐永康 黄吉平

Make a light pendulum with a small magnet at the free end. An adjacent electromagnet connected to an AC power source of a much higher frequency than the natural frequency of the pendulum can lead to undamped oscillations with various amplitudes. Study and explain the phenomenon.

制作一个自由端有一个小磁体的轻摆。一个临近的有频率远高于摆的固有频率交流电的电磁铁可以导致不同振幅的无阻尼振动。研究并解释这个现象。

#### 14. Circle of Light 环形光 苏卫锋 徐晓华

When a laser beam is aimed at a wire, a circle of light can be observed on a screen perpendicular to the wire. Explain this phenomenon and investigate how it depends on the relevant parameters.

当一个激光束瞄准一根金属丝，在垂直于金属丝的屏幕上可以观察到一个环形光线。解释这个现象并研究其与相关参量的依赖性。

15. Moving Brush 移动的刷子 陈唯 杨中芹

A brush may start moving when placed on a vibrating horizontal surface. Investigate the motion.

将刷子放置在振动的水平表面，刷子可能会开始移动。研究这一运动。

16. Wet and Dark 潮湿且黑暗 陈唯 杨中芹

Clothes can look darker or change colour when they get wet. Investigate the phenomenon.

当衣服受潮时会看起来更暗或者改变颜色。研究这一现象。

17. Coffee Cup 咖啡杯 吕景林 杨中芹

Physicists like drinking coffee, however walking between laboratories with a cup of coffee can be problematic. Investigate how the shape of the cup, speed of walking and other parameters affect the likelihood of coffee being spilt while walking.

物理学家们喜欢喝咖啡，但端着一杯咖啡在实验室间行走会很麻烦。研究杯子的形状、步行速度和其他参量如何影响走路时咖啡溅出的可能性。